F I G. 1

F I G. 2
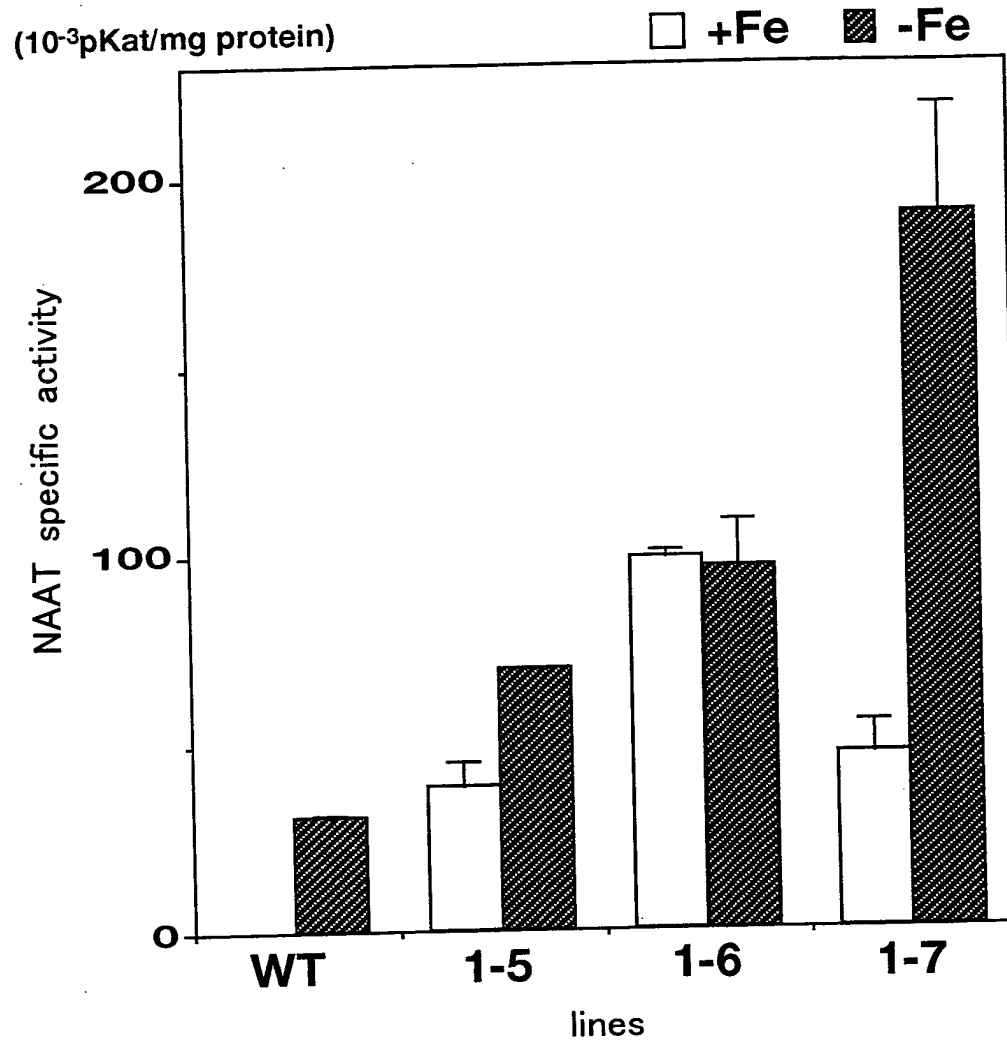
FIG. 3

FIG. 4

FIG. 5

F I G. 6
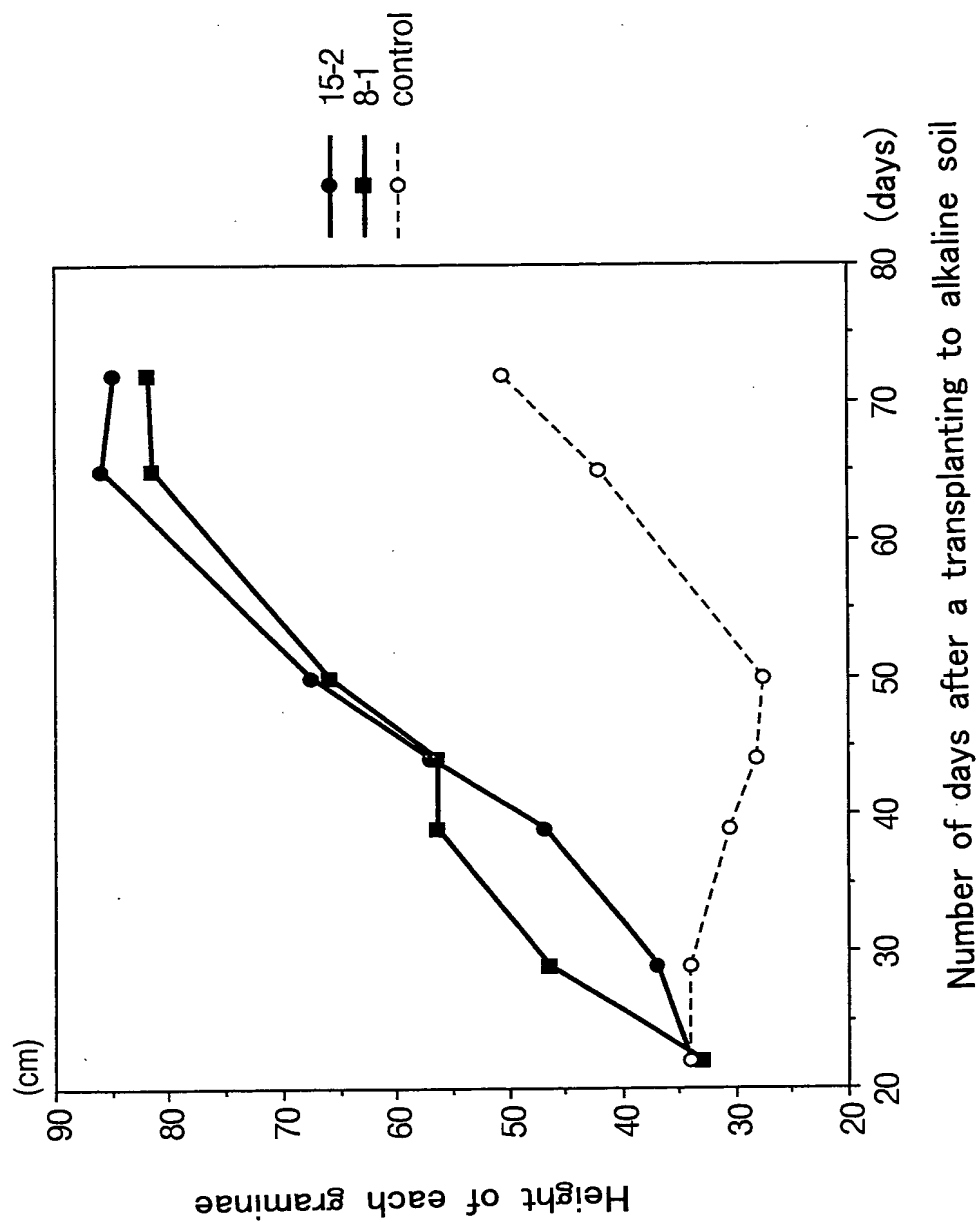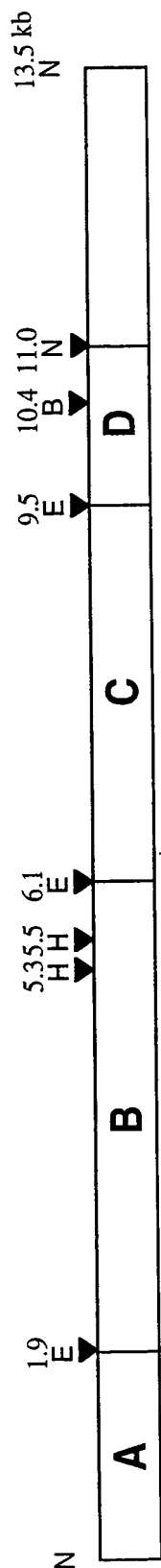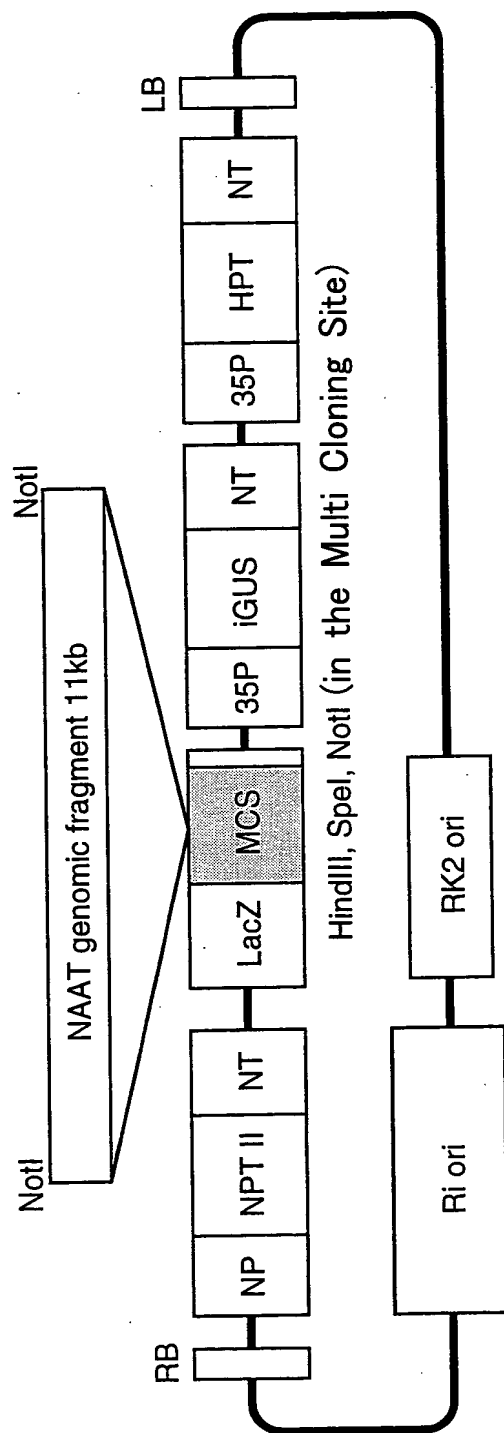
F I G. 7

E: *Eco* RI, H: *Hin* dIII, B: *Bam*HI, N: *Not* I.

The *Not* I site on both sides is the *Not* I located at the arm of λFIX II

F I G. 8

- NAAT genomic fragment 11kb
- NotI ... NotI
- RB
- NP
- NPT II
- NT
- LacZ
- MCS
- 35P
- iGUS
- NT
- 35P
- HPT
- NT
- LB
- Ri ori
- RK2 ori
- HindIII, SpeI, NotI (in the Multi Cloning Site)

F I G . 9

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catgccatattcttttgggtcaagtatgcagtatgttggaacctctttttagaaaatagat
acattgtactatgagtataccatttttattaagaatttcatattttgatatccttgatggt
attgttctcttgtgattcacacgatttacttgtggttttttgtactatcaaattgttcag
GCAGCTCTTCCTCAGATTCTTGAGAACACAAAGGAAGATTTCTTTAAGGCGATTATTGGT
 A  A  L  P  Q  I  L  E  N  T  K  E  D  F  F  K  A  I  I  G
```

```
CTGCTAAAGGAATCATCAGAGATATGCTACAACAAATAAAGGAAAACAAATACATTACA
 L  L  K  E  S  S  E  I  C  Y  K  Q  I  K  E  N  K  Y  I  T


TGTCCTCACAAGCCAGAAGGATCAATGTTTGTCATGgtaagcctatttttgtgaagtaaaa
 C  P  H  K  P  E  G  S  M  F  V  M


aaatcttagggagtgtcagtaatcataaacttatttatataggattaatctgggaccgaa  3000
atgcatccaacataattacttcaaattcaaattcaaattacattcttccgtacatatttt
tgaagatgcatgtattttaagaataatgacgagagctaaagttatgctacgactaatcat
ctggatatcctttgtccatctttttgttatactgtggaatgttaatggtcaaatcatatt
acacaaatatccatgctagtttctagaaagattgattatttttctgtaaccatgaactcc
gtattaacttccatgtaaacagGTGAAACTGAACTTACATCTTTTGGAGGAAATAGACGA
                       V  K  L  N  L  H  L  L  E  E  I  D  D


TGACATTGATTTTTGCTGCAAGCTCGCAAAAGAAGAATCAGTAATCTTATGCCCAGgtag
 D  I  D  F  C  C  K  L  A  K  E  E  S  V  I  L  C  P


gaatccattgttgatttttgactgtatatgaagttcttatcaatttccgagatgactata
catataaatgattaccatattatggtcagaaattgtataacagtgttagaatattctgtg
aagactttttttaacacaatattctgtgaagactagatatcatgtacttctccttgttttc
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tcaaataattgttaataatataatttagcctttaatttatatggttctattttgagatat
ttttgtagtccaacttatatatttgtgactattctcaaaaacaaaacttatatatgtgtg
cctctcaaatgtagGGAGTGTTCTTGGAATGGCAAACTGGGTCCGCATTACTTTTGCTTG
               G  S  V  L  G  M  A  N  W  V  R  I  T  F  A  C


TGTTCCATCTTCTCTTCAAGATGGTCTCGGAAGGATCAAATCATTCTGTCAAAGGAACAA
 V  P  S  S  L  Q  D  G  L  G  R  I  K  S  F  C  Q  R  N  K


GAAGAGAAATTCGAGCGATGATTGCTAGTTGTATATCTGACTGAAGCTGTAAATCATTCC
  K  R  N  S  S  D  D  C  *
CAGTATCCCCATCTATATCTTTCAATAAAATGGAACTTTTAGTTCTCTATGAATAGAAGT


CAACATCTCCTTGAATATGTTCTGGTTGTTGTGGCCTGGACGAAACATAGTGAATGTTAT


GTTAGTGAAGTTAcattggcgtcgaagatctttgaagttttttttttttttggggggggg


ggggggggggtgctttgatattactcttaagtacacgttctctcaagttatgtcaaagca
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aagcacaaaccctacctatgttaggctcactaaggtggcgtttggttcgagagagaggaa
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tcgcaggccggagtggtcaccatgcggaccaacaccaactccaacggggagcacgtcac
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gatcaaaattttaaaacgacttctttctcaaatttgagcaatatttaaaattataaaaaa
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```

```
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gagatatcatttctggattaggtacaattgtttttgccggcacagccaaaccccgcagtgg
agccggaattggaattgagtgggtggagtcgagaagcatggttcatgcgttctcaaagag
tgtagccagtagtgtgtgctccttggtgctggagctgcatatacaagtacataaaacaaa
gacgatcagctggcagcgtgcctgcatgcgtgcttcttgctgccgccccggaagccccgg
ttgatgtgcgcaggcgagtggcgacgggaccgacggctataaagcacggccaagcaccgc
cgccgttctcaatccatccatcccttagctgatttgATTGACTAGCTAGTTCATTCCCTG
```

```
CCACACTGCTAGTACTCCTCCTCGTTTCCTCGTGGCAATGGTACACCAGAGCAACGGCCA
                                    M  V  H  Q  S  N  G  H   NAAT-A
```

```
CGGCGAGGCCGCCGCCGCCGCCAACGGCAAGAGCAACGGGCACGCCGCCGCCGCGAA  6600
 G  E  A  A  A  A  A  A  N  G  K  S  N  G  H  A  A  A  A  N
```

```
CGGCAAGAGCAACGGGCACGCGGCGGCGGCGGCGGTGGAGTGGAATTTCGCCCGGGGCAA
 G  K  S  N  G  H  A  A  A  A  A  V  E  W  N  F  A  R  G  K
```

```
GGACGGCATCCTGGCGACGACGGGGGCGAAGAACAGCATCCGGGCGATACGGTACAAGAT
 D  G  I  L  A  T  T  G  A  K  N  S  I  R  A  I  R  Y  K  I
```

```
CAGCGCGAGCGTGGAGGAGAGCGGGCCGCGGCCCGTGCTGCCGCTGGCCCACGGTGACCC
 S  A  S  V  E  E  S  G  P  R  P  V  L  P  L  A  H  G  D  P
```

```
GTCCGTGTTCCCGGCCTTCCGCACGGCCGTCGAGGCCGAGGACGCCGTCGCCGCCGCGCT
 S  V  F  P  A  F  R  T  A  V  E  A  E  D  A  V  A  A  A  L
```

```
GCGCACCGGCCAGTTCAACTGCTACGCCGCCGGNNTCGGCCTCCCCGCCGCACGAAGgta
 R  T  G  Q  F  N  C  Y  A  A  G  V  G  L  P  A  A  R  S
```

```
acatttacagcttcaccgtaatgtatgcgtgagcatgcatgcgccggtttacttacgtgc
ccgccgctgttcttccccggtgcgttcaaaattttaaccttctataagtaccttataaaa
acaaacagCGCCGTAGCAGAGCACTTGTCACAGGGCGTGCCCTACAAGCTATCGGCCGAC
        A  V  A  E  H  L  S  Q  G  V  P  Y  K  L  S  A  D
```

```
GACGTCTTCCTCACCGCCGGCGGAACTCAGGCGATCGAAGTCATAATCCCGGTGCTGGCC
  D  V  F  L  T  A  G  G  T  Q  A  I  E  V  I  I  P  V  L  A

CAGACTGCCGGCGCCAACATACTGCTTCCCCGGCCAGGCTATCCAAATTACGAGGCGCGA  7200
  Q  T  A  G  A  N  I  L  L  P  R  P  G  Y  P  N  Y  E  A  R

GCGGCATTCAACAAGCTGGAGGTCCGGCACTTCGACCTCATCCCCGACAAGGGGTGGGAG
  A  A  F  N  K  L  E  V  R  H  F  D  L  I  P  D  K  G  W  E

ATCGACATCGACTCGCTGGAATCCATCGCCGACAAGAACACCACCGCGATGGTCATCATA
  I  D  I  D  S  L  E  S  I  A  D  K  N  T  T  A  M  V  I  I

AACCCAAACAATCCGTGCGGCAGCGTTTACTCCTACGACCATCTGGCCAAGgttttgcat
  N  P  N  N  P  C  G  S  V  Y  S  Y  D  H  L  A  K

ccatgcatcctctgcctcgttgatcgaccggtctgtttgaacatagtatatggattgcgt
ttgctaatcgtgtgctgatgatgctgtttggttatcagGTCGCGGAGGTGGCAAGGAAGC
                                        V  A  E  V  A  R  K

TCGGAATATTGGTGATCGCTGACGAGGTTTACGGCAAACTGGTTCTGGGCAGCGCCCCGT
  L  G  I  L  V  I  A  D  E  V  Y  G  K  L  V  L  G  S  A  P

TTATCCCGATGGGCGTCTTTGGGCACATTGCCCCGGTCTTGTCCATTGGATCTCTGTCCA
  F  I  P  M  G  V  F  G  H  I  A  P  V  L  S  I  G  S  L  S

AGTCGTGGATAGTGCCTGGATGGCGACTTGGATGGGTGGCGGTGTACGACCCCACAAAGA
  K  S  W  I  V  P  G  W  R  L  G  W  V  A  V  Y  D  P  T  K

TTTTAGAGAAAACTAAGgtagctttagctccctatcattcttctcatatgctactgtggg
  I  L  E  K  T  K

gattagtattttgctaaatttgtactgcctttgtttattcagATCTCTACGTCTATTAC  7800
                                           I  S  T  S  I  T

GAATTACCTTAATGTCTCAACGGACCCAGCAACCTTCGTTCAGgttagtctttggttctt
  N  Y  L  N  V  S  T  D  P  A  T  F  V  Q
gccctattttgctcatgtccctgtgttgcatgtcaaatgaccggcttcaagttagtatat
agagttttttgttaagtgtgaatgtcgaagtccaacatgatggaagaaagatacatctatt
tttagtcattcccctttgtttgtttgattccataaaataaataaacacaaagccagaacc
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gttaagaatttctttacctacaacaccttgtctcgcatcttcatattttgatatccttga
cattattgttctcttatgattcacacaacttaattatggattttttgtgctatcaaattgt
ttagGAAGCTCTTCCTAAAATTCTTGAGAACACAAAAGCAGATTTCTTTAAGAGGATTAT
    E  A  L  P  K  I  L  E  N  T  K  A  D  F  F  K  R  I  I

TGGTCTACTAAAGGAATCATCAGAGATATGTTATAGGGAAATAAAGGAAAACAAATATAT  8400
  G  L  L  K  E  S  S  E  I  C  Y  R  E  I  K  E  N  K  Y  I

TACGTGTCCTCACAAGCCAGAAGGATCGATGTTTGTAATGgtaagctaagcatagactta
  T  C  P  H  K  P  E  G  S  M  F  V  M
```

17/25

cttttttaaggttaatctgggatctcagtgcatccaacaaacaatcaaatcaaaatataat
tatgttttgctatggatctttttgaagatgcatgcatttgaagaataatgaagagagttg
·aaattattttaggactaatcttcctgatatcatttgtccattttttttgttattactgtaa
attggtaacactcaaatcatattacaaaaagtttcctcccattttttagtaagattgactt
cctttctataaccatgtattaacttccatgtaaacagGTCAAACTAAACTTACATCTTTT
                                       V K L N L H L L

GGAGGAGATCCATGACGACATAAATTTTTGCTGCAAGCTCGCAAAGGAAGAATCTGTAAT
 E E I H D D I N F C C K L A K E E S V I

TTTATGTCCAGgtaggaatgtatatggccattttaaaggaaaactatatggaataataat
 L C P

atcttcttgttatactaaacaatacttcctccatcctaaaataaatgtcttacacttagc
acaattttatactagatctagtacaaagttgaaacagttattttgggacagagggagtag 9000
tatatattgtgtgagaacataaggttatgtttgactgatatatgcttcttaaatgtgaaa
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ttttatgcaaagactagcatggcatgtacttttccttgtacctatgtgtctttttttttc
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attaataattttgaggtgttttttcaaccaacttatatactttcatagttctaaaaaaacc
gtatatatggttaactctaacaaaaacttatatatgttttctctctaatacagGGAGTGT
                                                       G S V

TCTTGGAATGGAAAATTGGGTCCGTATTACTTTTGCCTGCGTTCCATCTTCTCTTCAAGA
 L G M E N W V R I T F A C V P S S L Q D

TGGACTCGAAAGGGTCAAATCATTCTGTCAAAGGAACAAGAAGAAGAATTCTATAAATGG
 G L E R V K S F C Q R N K K K N S I N G

TTGTTAGTTGTACACACCCCTAGTTGTACATCTGACTGAAGCTGTAAATCATTTCTAGTT 9600
 C *
ATCCCCATTTATATATTTCAATAAAACATATTGTAATGGTTCTGTTGTAGCTGTCCAAGT

CATGTACTCTACTTTTTGATGTATTTGGCCTCATTGCCTTGCATCAGTTTCAATAAAAAT

GGTTGTGTACACaatgatgatgtagaggcgaggtgttttgaccacctttttcaacaaaaat

ctatatctttcaacaaatgaaaccttgagttccctttgagtagaagtcaacatactcctt
gaatatgctatggtttccatggtctggatgaaacatgatgaatagaagtgaagttatatc
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ggggggggtgaataggcggtttataaccaattgtatatttgagaatatcttaatgtgga
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tcaagggatacaatcataatgagtacacaatcgacatctacataatcaggttgcatacgg 10200
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gtcatacaagatcaaaactatgcctaggcggaggaagaatagaaaaacatgaagaaatga
aaaaccgtgactgacaacatactgaccatcgacgacaaacatctgtagacaacacaaaaa
ctgcgagaaaagttctataaaactggcgccttcgagaaggaaacgacgtgcaagagttgc
catcatcggatccaaccactaaggtcatatcctgggttttcatcctgaagatcaaatccg
agcaaactccgagtaatgtctttattagggtaacgattcaaaaaatgccacaatcatgag

```
ttatgaccaattagaccagacctaggattttttatccaaagctcgagacgggtactctaga
agtaccatccaattgaagtcatcccacttgcctcaatacaaatagttgcatagatgcacg
gtccatatggcgagtaatggacatgagcgcgcatgtgtaggttaacgtgacgtgacaaga
gcctgtcgccaccactcgacgaagtgtttgatggggaggaagaagtatggctccaccaac  10800
atcccaagtttgaaacattctagagcccccttaccatactcacaaagcgacaattgatgac
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```
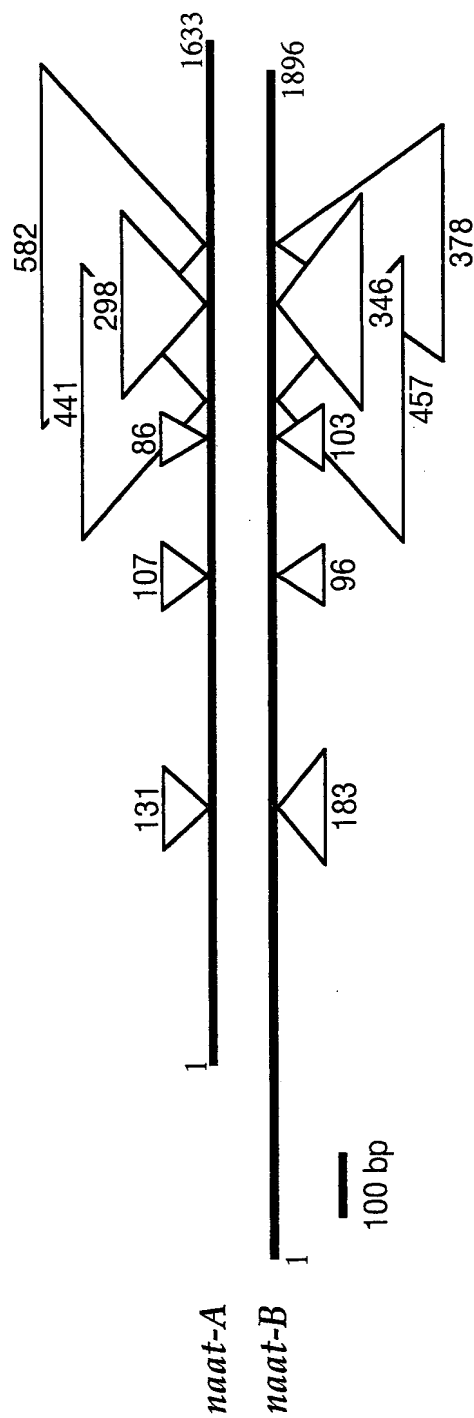
F I G. 11

naat-B exon

naat-A exon
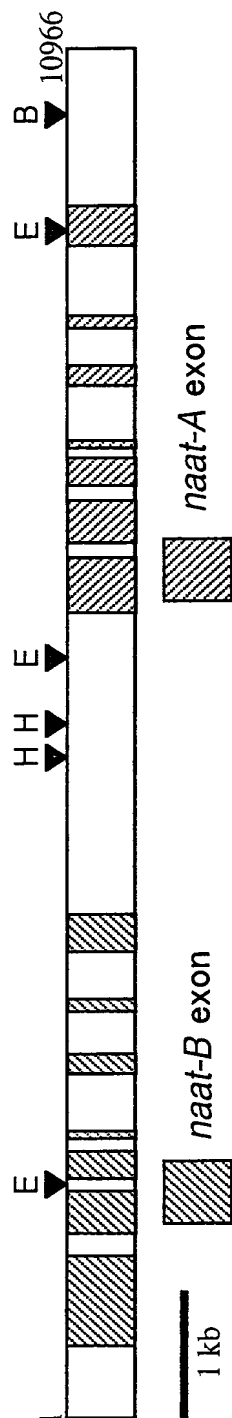
E: *EcoRI*, H: *HindIII*, B: *BamHI*.

A schematic view of the obtained genome fragment

F I G. 1 2

naat-A
naat-B

100 bp

FIG. 13

MVHQSNGHGEAAAAAANGKSNGHAAAANGKSNGHAAAAAVEWNFARGKDGILATTGAKNS
IRAIRYKISASVEESGPRPVLPLAHGDPSVFPAFRTAVEAEDAVAAALRTGQFNCYAAGV
GLPAARSAVAEHLSQGVPYKLSADDVFLTAGGTQAIEVIIPVLAQTAGANILLPRPGYPN
YEARAAFNKLEVRHFDLIPDKGWEIDIDSLESIADKNTTAMVIINPNNPCGSVYSYDHLA
KVAEVARKLGILVIADEVYGKLVLGSAPFIPMGVFGHIAPVLSIGSLSKSWIVPGWRLGW
VAVYDPTKILEKTKISTSITNYLNVSTDPATFVQEALPKILENTKADFFKRIIGLLKESS
EICYREIKENKYITCPHKPEGSMFVMVKLNLHLLEEIHDDINFCCKLAKEESVILCPGSV
LGMENWVRITFACVPSSLQDGLERVKSFCQRNKKKNSINGC*

FIG. 14

ATVRQSDGVAANGLAVAAAAANGKSNGHGVAAAVNGKSNGHGVDADANGKSNGHGVAADAN
GKSNGHAEATANGHGEATANGKTNGHRESNGHAEAADANGESNEHAEDSAANGESNGHAA
AAAEEEEAVEWNFAGAKDGVLAATGANMSIRAIRYKISASVQEKGPRPVLPLAHGDPSVF
PAFRTAVEAEDAVAAALRTGQFNCYPAGVGLPAARSAVAEHLSQGVPYMLSADDVFLTAG
GTQAIEVIIPVLAQTAGANILLPRPGYPNYEARAAFNRLEVRHFDLIPDKGWEIDIDSLE
SIADKNTTAMVIINPNNPCGSVYSYDHLSKVAEVAKRLGILVIADEVYGKLVLGSAPFIP
MGVFGHITPVLSIGSLSKSWIVPGWRLGWVAVYDPRKILQETKISTSITNYLNVSTDPAT
FIQAALPQILENTKEDFFKAIIGLLKESSEICYKQIKENKYITCPHKPEGSMFVMVKLNL
HLLEEIDDDIDFCCKLAKEESVILCPGSVLGMANWVRITFACVPSSLQDGLGRIKSFCQR
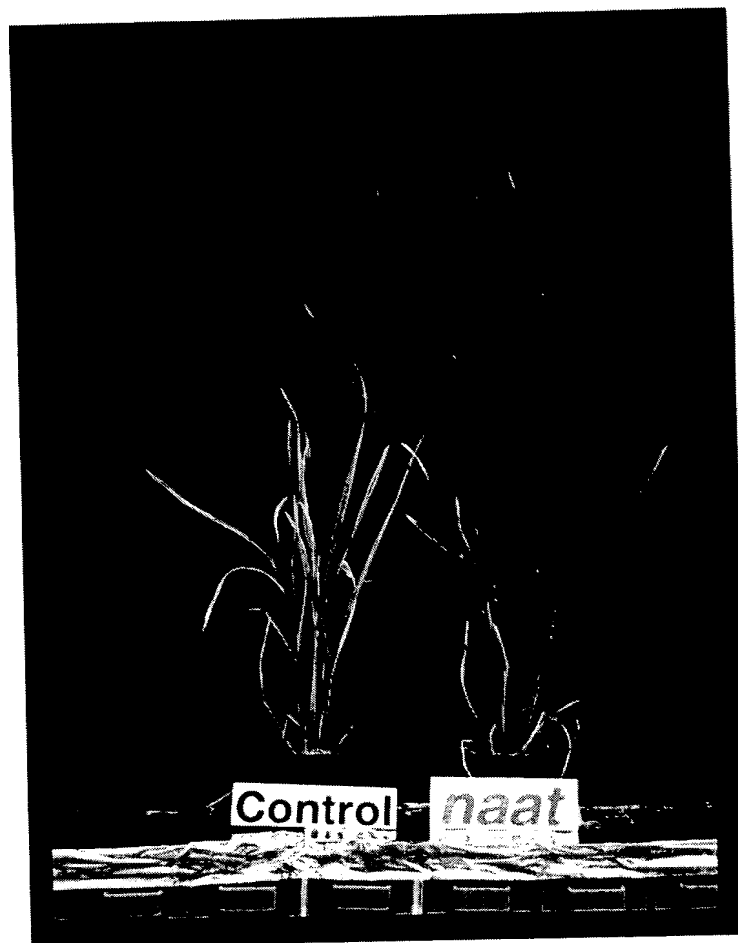NKKRNSSDDC*

FIG. 15 A

FIG. 15 B

Control naat

F I G. 1 6

control rice

rice transformed with *naat*

(cm)

Height of each rice

100
80
60
40
20

100
80
60
40
20

30   40   50   60   70   80   90 (days)

30   40   50   60   70   80   90

Number of days after a transplanting to alkaline soil